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WATERTOWN ARSENAL
LABORATORY

MEMORANDUM REPORT

NO. WAL 710/738

AD-A954 973

Resistance of Hadfield Manganese Steel in Form of Helmet, M1,
to Perforation by Fragment-Simulator, G-2

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BY
J. F. SULLIVAN
Asst. Engineer

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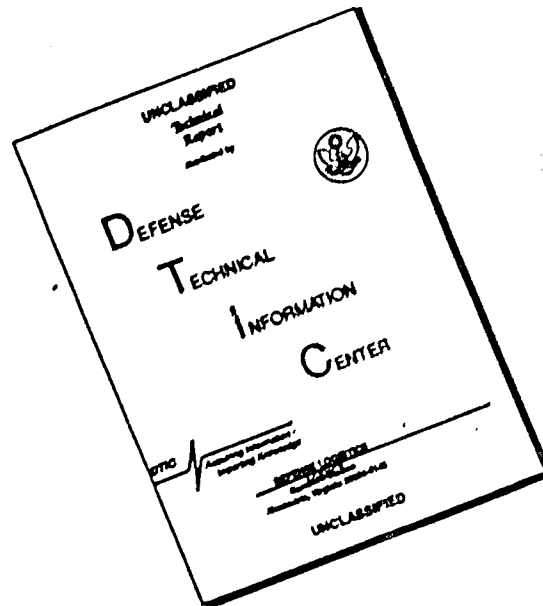
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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT NO. WAL 710/738

Partial Report on Problem B-8.2

26 April 1945

Resistance of Hadfield Manganese Steel in Form of Helmet, M1,
to Perforation by Fragment-Simulator, G-2

1. At the request of the Office, Chief of Ordnance¹, the resistance of Hadfield manganese steel of varying thickness in the form of Helmet, M1, has recently been investigated at this arsenal.

2. In comparison with the same material in flat sheet form, as impacted at normal incidence, Hadfield manganese steel in the subject form exhibited a tremendous decrease in resistance to perforation by the fragment-simulator, G-2². This, however, does not necessarily indicate a comparable decrease in the material's resistance to perforation by actual fragments.

3. Helmets of Schlueter Manufacturing Company make were selected at random and subjected to impact with G-2 projectiles. Care was taken to insure that the helmet surface impacted was tangent, at the point of impact, with a plane perpendicular to the line of flight of the projectile. The results of individual rounds are shown in Figure 1. The conclusions as to the relationship between thickness at the point impacted and ballistic limit are set out in Table I.

4. Earlier tests of Hadfield manganese steel in the form of flat sheet have indicated that when impacted at normal incidence by this projectile its resistance to perforation is much greater (about 1675 feet-per-second for .045" gauge). Other tests not yet completed, however, have indicated that at oblique incidence (up to 45°) the resistance of the material is much lower than at normal incidence.

1. O.O. 421/3566 - Wtn 421/509, 7 April 1945.

2. WAL 762/253(c)

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5. These phenomena throw some light on the lack of correlation between the results of actual fragmentation tests and ballistic limit tests with the G-2 projectile at normal incidence. Their discrepancy with the results which would be expected of the usual armor with curved surfaces or at obliquity (where resistance usually increases) is also explainable.

6. The efficiency with which Hadfield manganese steel resists perforation at normal incidence by the fragment-simulating G-2 stems from its ability to deform plastically over a considerable area before failing. When in the form of a helmet the structure effectively limits the amount of deformation possible before failure. Similarly when the direction of impact varies from normal, the area subject to deformation is decreased and failure occurs earlier.

7. Since in a fragmentation test, the great majority of fragments attack a flat sheet of Hadfield manganese steel obliquely, it is reasonable that a lack of correlation between results at normal incidence and those under actual fragmentation develops.

8. Although the obliquities at which actual fragments attack the flat sheet vary considerably it may be possible that tests at some one obliquity or at some combination of obliquities may disclose a correlation with actual fragmentation results. Experiments will be undertaken to test this possibility.

J. F. Sullivan
J. F. Sullivan
Asst. Engineer

APPROVED BY:

E. L. Reed
E. L. REED
Research Metallurgist
Acting Chief, Armor Section

TABLE I

Resistance of Hadfield Manganese Steel in Form of a Helmet, M1,
to Perforation by the Fragment-Simulator, G-2

<u>Thickness of Helmet</u> <u>at Point of Impact</u>	<u>Apparent</u> <u>Ballistic Limit (A)</u>
.036"	965 f/s
.037"	935
.038"	1000
.039"	1015
.040"	1040
.041"	1070
.042"	1110
.043"	1155
.044"	1210
.045"	1275

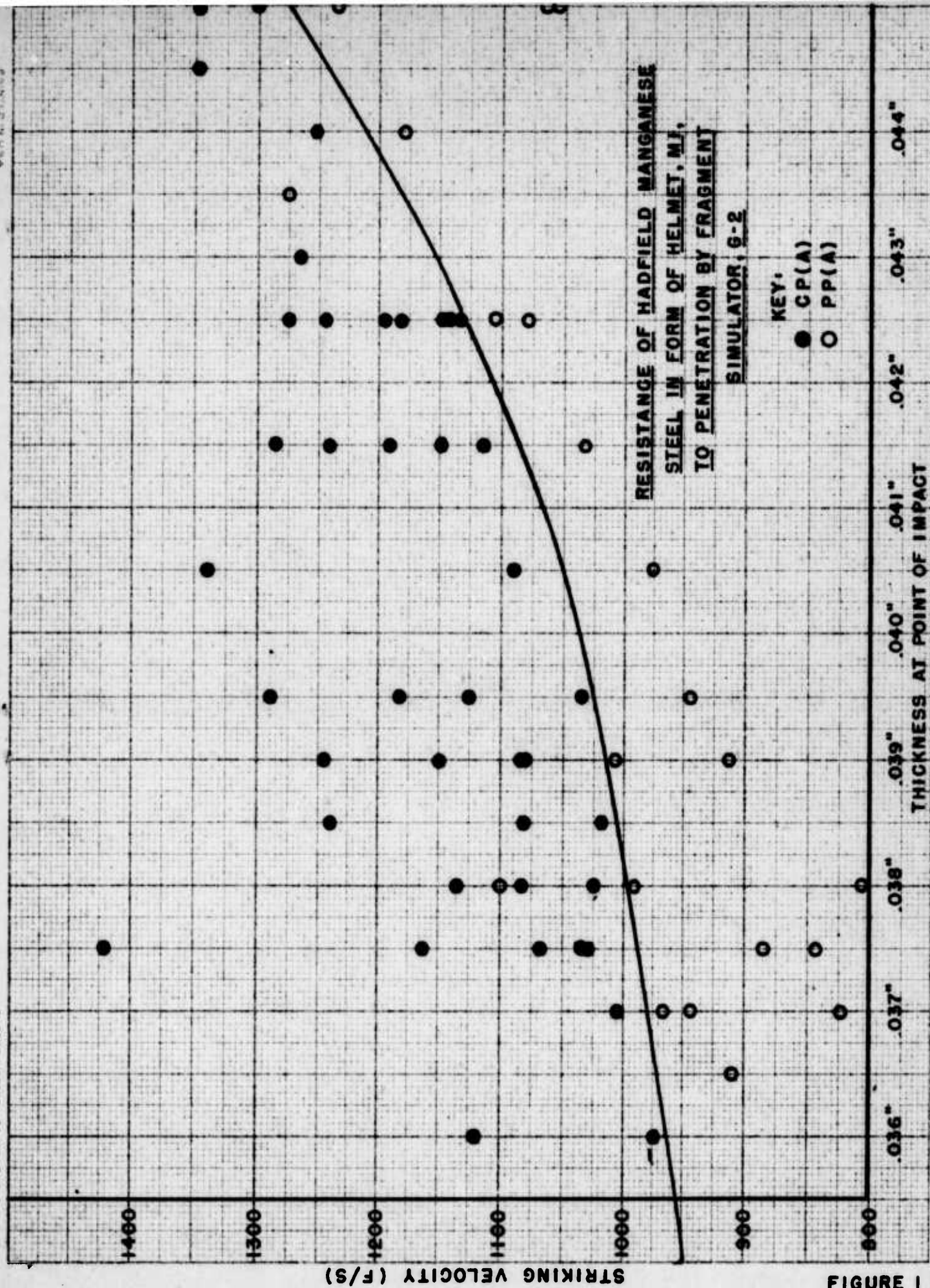


FIGURE 1